NISTTech

Nanolubricants for Enhancing the Nucleative Heat Transfer of Refrigerant Chiller Evaporators

Nanoadditives dramatically improve energy efficiency in large cooling systems (chillers)

Description

Adding just the right dash of nanoparticles to standard mixes of lubricants and refrigerants could yield the equivalent of an energy-saving "chill pill" for factories, hospitals, ships, and others with large cooling systems, suggest the latest results from NIST research that is pursuing promising formulations.

NIST experiments with varying concentrations of nanoparticle additives indicate a major opportunity to improve the energy efficiency of large industrial, commercial, and institutional cooling systems known as chillers. These systems account for about 13 % of the power consumed by the nation's buildings, and about 9 percent of the overall demand for electric power, according to the Department of Energy.

By dispersing sufficient amounts of copper oxide particles (30 nanometers in diameter) in a common polyester lubricant and combining it with an equally pedestrian refrigerant (R134a), heat transfer improves by between 50% and 275%.

Just how nanomaterial additives to lubricants improve the dynamics of heat transfer in refrigerant/lubricant mixtures is not thoroughly understood. The NIST research effort aims to fill gaps in knowledge that impede efforts to determine and, ultimately, predict optimal combinations of the three types of substances.

Several factors likely account for nanoparticle-enabled improvements in heat-transfer performance. For one, nanoparticles of materials with high thermal conductivity improve heat transfer rates for the system. Preliminary results of the NIST research also indicate that, in sufficient concentrations, nanomaterials enhance heat transfer by encouraging more vigorous boiling of the mixture. The tiny particles stimulate, in effect, double bubbles—secondary bubbles that form atop bubbles initiated at the boiling site. Bubbles carry heat away from the surface, and the fact that they're being formed more efficiently because of the nanoparticles means the heat gets transferred more readily.

Success in optimizing recipes of refrigerants, lubricants and nanoparticle additives would pay immediate and long-term dividends. If they did not harm other aspects of equipment performance, high-performance mixtures could be swapped into existing chillers, resulting in immediate energy savings. And, because of improved energy efficiency, next-generation equipment would be smaller, requiring fewer raw materials in their manufacture.

Abstract

A National Institute of Standards and Technology (NIST) researcher has come up with a method designed to improve the energy efficiency of water chillers that cool the nation's large commercial buildings. The NIST method, if confirmed through

experiments with full-scale chiller systems, could save as much as 1 percent of the 320 billion kWh of electricity used annually by chillers or an equivalent 5.5 million barrels of oil per year, according to Mark Kedzierski, the NIST mechanical engineer who developed the technique.

Inventors

- Kedzierski, Mark

Related Items

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Status of Availability

This technology is available in the public domain.

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